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BASIC Application Program–Business / Social Studies

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DEC EDUCATIONAL PUBLICATIONS

Other publications in the continuing series of curriculum material published by DEC for use with EduSystems 10 through 80 are listed below. Please inquire directly for prices on classroom quantities.

Additional publications may be obtained from:

Program Library
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BASIC APPLICATION PROGRAMS

The programs contained in this series are designed to demonstrate how the computer can be applied in a meaningful way to problems of many disciplines. The problems and the corresponding programs are, for the most part, quite simple and are designed to be "jumping off points" for students from the high school level on up.

All of the programs, with very few exceptions, may be run on EduSystems 10 through 80, PDP-8 Family and PDP-11 Family computers. Exceptions are noted in the program descriptions.

DEC welcomes contributions of programs and write-ups for use in this series. Contributors will be credited as program "Source". Please send programs and descriptions to Educational Marketing (5-2).

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BUSINESS/SOCIAL STUDIES

Business	DEPRECIATE	Demonstrates 3 methods of depreciation.
	FIFO	Demonstrates FIFO inventory method.
	INDIAN	Manhattan Island interest problem.
	INT-1	Interest compounding given one principal amount.
	INT-2	Interest compounding with regular deposits.
	ROUNDOFF	Rounds off numbers to any number of places.
	SORT-1	Sorts a list of numbers.
	SORT-2	Sorts a list of numbers (2nd method).
Social Studies	POPULATION	Examines population growth of the U. S. and Mexico.
	SMOG	Simulates the generation of smog from automobiles.

AREA: Business NUMBER: NAME: DEPRECIATE
SOURCE: Digital Equipment Corp. LANGUAGE: BASIC

DESCRIPTION: This program shows how a piece of capital equipment depreciates according to three commonly used depreciation methods: straight line, sum of the digits, and double declining.

```
120 PRINT "ORIGINAL COST";
130 INPUT C
140 PRINT " LIFE OF ITEM";
150 INPUT L
160 PRINT "  SCRAP VALUE";
170 INPUT S
180 PRINT
190 PRINT "YEAR","STRAIGHT","SUM OF"," DOUBLE"
200 PRINT " ","  LINE","DIGITS","DECLINING"
210 PRINT
220 LET V=C-S
230 LET D1=V/L
240 LET Y=((L+1)/2)*L
250 LET Z=L
260 FOR X=1 TO L
270 LET D2=V*(Z/Y)
280 LET Z=Z-1
290 LET D3=2*C/L
300 LET C=C-D3
310 PRINT X,
312 LET Q=D1
314 GOSUB 400
316 LET Q=D2
318 GOSUB 400
320 LET Q=D3
322 GOSUB 400
325 PRINT
330 NEXT X
350 STOP
400 LET Q=INT(Q*100)/100
420 IF Q>100 THEN 440
430 PRINT " ";
440 IF Q>10 THEN 460
450 PRINT " ";
460 PRINT "$"Q,
490 RETURN
999 END
```

USAGE: Load the DEPRECIATE program and type RUN. Enter the purchase price of the item, its life in years, and its scrap value at the end of that time.

```
RUN

ORIGINAL COST? 1000
 LIFE OF ITEM? 5
  SCRAP VALUE? 100

YEAR          STRAIGHT      SUM OF        DOUBLE
                LINE        DIGITS       DECLINING

 1            $ 180         $ 300         $ 400
 2            $ 180         $ 240         $ 240
 3            $ 180         $ 180         $ 144
 4            $ 180         $ 120          $ 86.4
 5            $ 180          $ 60          $ 51.84

READY

RUN

ORIGINAL COST? 2000
 LIFE OF ITEM? 4
  SCRAP VALUE? 300

YEAR          STRAIGHT      SUM OF        DOUBLE
                LINE        DIGITS       DECLINING

 1            $ 425         $ 680         $ 1000
 2            $ 425         $ 510         $ 500
 3            $ 425         $ 340         $ 250
 4            $ 425         $ 170         $ 125

READY
```

EDUCATIONAL BENEFITS: The study of "general business" is often just the study of a lot of tables in a textbook. It's hard for a student to get involved in this work, since he often doesn't understand what is behind these tables. The computer can bring many of these topics to life.

Also, by having some exposure to a computer, the student learns to be comfortable with it. He will be much better prepared for work in a modern business.

AREA: Business NUMBER: NAME: FIFO
SOURCE: Gregg Accounting, Advanced Course LANGUAGE: BASIC
Gregg, McGraw-Hill, 2d edition (EduSystem 10)

DESCRIPTION: This program demonstrates the First-in, First-out (FIFO) method of inventory evaluation that is used by many businesses.

APPROACH: We read the beginning inventory from a DATA statement and put the quantity and price information into a simple array Q(X), P(X) . Each time units are removed from inventory we cycle through the array, removing items from inventory in the same order they were placed into the inventory. When zero units remain at one price, the next set of units are taken at the next price. This program accepts six sets of data in Line 40.

EDUCATIONAL APPLICATIONS: Used to show how FIFO works. Change the price information in Line 40 (quantity, then price) to show the affect FIFO has on shipment values in terms of falling costs (example uses rising costs). Let your students rewrite the program for Last-in, First-out (LIFO) inventory evaluation.

*Program is coded using multiple statements per line feature of certain EduSystems.

```
LIST
1 REM ARK-FIFO
2 FOR X=1 TO 6\READ Q(X),P(X)\NEXT X\S=X-1
6 GOSUB 20 \PRINT "ENTER QUANTITY REMOVED";\INPUT W\PRINT "SHIPPED OUT"
8 PRINT "NUMBER","PRICE","TOTAL"
10 FOR X=1 TO S\IF Q(X)=0 THEN 18
12 IF Q(X)-W>=0 THEN 34
14 PRINT Q(X),P(X),(Q(X)*P(X))
16 T1=T1+(Q(X)*P(X))\W=W-Q(X)\Q(X)=0
18 NEXT X\IF Q(X+1)<=0 THEN 38
20 PRINT "REMAINING INVENTORY"\T=0
22 PRINT "NUMBER","PRICE","TOTAL"
24 FOR X=1 TO S\IF Q(X)<=0 THEN 30
26 PRINT Q(X),P(X),(Q(X)*P(X))
28 T=T+(Q(X)*P(X))
30 NEXT X
32 PRINT "TOTAL VALUE ="T\PRINT \RETURN
34 PRINT W,P(X),W*P(X)\T1=T1+(W*P(X))
36 PRINT "SHIPPED VALUE="T1\T1=0\Q(X)=Q(X)-W\GO TO 6
38 PRINT "OUT OF INVENTORY"\PRINT "SHIPPED VALUE ="T1
40 DATA 35,11.25,60,12,100,12.5,50,13,80,13.5,40,14.25\END
```

```
RUN
REMAINING INVENTORY
NUMBER         PRICE          TOTAL
 35             11.25          393.75
 60             12             720
 100            12.5           1250
 50             13             650
 80             13.5           1080
 40             14.25          570
TOTAL VALUE = 4663.75

ENTER QUANTITY REMOVED?100
SHIPPED OUT
NUMBER         PRICE          TOTAL
 35             11.25          393.75
 60             12             720
 5              12.5           62.5
SHIPPED VALUE= 1176.25
REMAINING INVENTORY
NUMBER         PRICE          TOTAL
 95             12.5           1187.5
 50             13             650
 80             13.5           1080
 40             14.25          570
TOTAL VALUE = 3487.5
```

AREA: Business/Math NUMBER: NAME: INDIAN
SOURCE: NREL/SDC LANGUAGE: BASIC

DESCRIPTION: This program solves a simple interest problem which makes one think twice about the deal that the Dutch made with the Indians. If the $24 which the Indians received in 1626 for Manhattan Island had been deposited in a bank paying 5-3/4% interest compounded annually, what would it have amounted to by 1971?

APPROACH: If P dollars are invested at an interest rate of r (expressed as a decimal) compounded n times, the total amount A is given by the formula:

$$A = P(1 + r)^n$$

How much was gained in 1971 alone?

```
10 LET P=24
20 LET R=.0575
30 LET N=1971-1626
40 LET A=P*((1+R)↑N)
50 PRINT "IF THE $24 WHICH THE INDIANS RECEIVED IN 1626 FOR"
 60 PRINT "MANHATTAN ISLAND HAD BEEN DEPOSITED IN A BANK"
 70 PRINT "PAYING"R*100"% INTEREST COMPOUNDED ANNUALLY, IT WOULD"
 80 PRINT "HAVE AMOUNTED TO $"A"BY 1971."
99 END

READY

RUN

IF THE $24 WHICH THE INDIANS RECEIVED IN 1626 FOR
MANHATTAN ISLAND HAD BEEN DEPOSITED IN A BANK
PAYING 5.75 % INTEREST COMPOUNDED ANNUALLY, IT WOULD
HAVE AMOUNTED TO $ 5.713946E+9 BY 1971.


READY
```

AREA: Business, Math NUMBER: NAME: INT-1
SOURCE: CAMP Algebra, DEC LANGUAGE: BASIC

DESCRIPTION: This program illustrates how interest accumulates using compound interest methods as compared to using simple interest.

Input principal, interest rate, and number of times compounded each year. For each year, the program calculates interest earnings.

(1) assuming simple interest.
(2) assuming interest is compounded.

The computer will print your year end account balance each year for 10 years. You should use even dollar figures for the principal amount to make it easier to "see" the difference.

```
 5 REM   PROGRAM INT-1
10 REM   SIMPLE AND QUARTERLY COMPUUND INTEREST
14 PRINT "WHAT IS THE PRINCIPAL AMOUNT";
18 INPUT P
22 PRINT "WHAT IS THE RATE OF INTEREST (X.XX)";
26 INPUT R
27 PRINT "COMPOUNDED HOW MANY TIMES PER YEAR";
28 INPUT N
30 LET R=R/100
34 LET A=P*R
38 LET S=P+A
40 PRINT
42 PRINT "YEAR","SIMPLE","COMPOUND"
46 FOR Y=1 TO 10
50 FOR X=1 TO N
54 LET P=P*(1+R/N)
58 NEXT X
62 PRINT Y,S,P
66 LET S=S+A
70 NEXT Y
74 PRINT
78 GOTO 14
99 END
```

```
RUN

WHAT IS THE PRINCIPAL AMOUNT? 1000
WHAT IS THE RATE OF INTEREST (X.XX)? 5.25
COMPOUNDED HOW MANY TIMES PER YEAR? 4

YEAR              SIMPLE            COMPOUND
 1                 1052.5            1053.543
 2                 1105              1109.952
 3                 1157.5            1169.382
 4                 1210              1231.994
 5                 1262.5            1297.958
 6                 1315              1367.454
 7                 1367.5            1440.671
 8                 1420              1517.808
 9                 1472.5            1599.075
 10                1525              1684.694

WHAT IS THE PRINCIPAL AMOUNT? 1000
WHAT IS THE RATE OF INTEREST (X.XX)? 5.25
COMPOUNDED HOW MANY TIMES PER YEAR? 365

YEAR              SIMPLE            COMPOUND
 1                 1052.5            1053.895
 2                 1105              1110.695
 3                 1157.5            1170.555
 4                 1210              1233.642
 5                 1262.5            1300.129
 6                 1315              1370.199
 7                 1367.5            1444.046
 8                 1420              1521.873
 9                 1472.5            1603.894
 10                1525              1690.336

WHAT IS THE PRINCIPAL AMOUNT? 1
WHAT IS THE RATE OF INTEREST (X.XX)? 100
COMPOUNDED HOW MANY TIMES PER YEAR? 1000

YEAR              SIMPLE            COMPOUND
 1                 2                 2.716889

↑C

READY
```

EDUCATIONAL BENEFITS: The computer is used to demonstrate the advantages of interest compounding. By using different interest rates you can illustrate the importance of shopping around for a higher interest rate for your savings.

In the last example, we used a 100% (!) rate of interest and compounded it 1000 times per year. Try it compounding it 5000 times per year (run time will be in minutes). Does the compound interest amount begin to look like the constant "e"? Why?

AREA: Business NUMBER: NAME: INT-2
SOURCE: Huntington Computer Project LANGUAGE: BASIC

DESCRIPTION: This program will calculate the balance of a savings account in which deposits are made regularly. Pick an amount of money to save each month and pick how many years you will save it and this program will tell you how much you will have at the end of that time.

USAGE: In any class where thrift or savings is taught this program can be used to illustrate how quickly money can accumulate when you make <u>regular</u> savings deposits. You may also use this program to show how small differences in interest rates can make significant differences in your interest earnings.

```
4 PRINT "THIS PROGRAM WILL CALCULATE THE BALANCE OF A SAVINGS"
5 PRINT "ACCOUNT IN WHICH DEPOSITS ARE MADE REGULARLY."
6 PRINT
7 PRINT "HOW MUCH WILL YOU SAVE EACH MONTH";
8 INPUT A
10 PRINT "HOW MANY INTEREST COMP OUND PERIODS EACH YEAR";
12 INPUT B
14 PRINT "AT WHAT RATE OF INTEREST (XX.X%)";
16 INPUT C
18 PRINT "HOW MANY YEARS WILL YOU MAKE THIS SAVING";
19 INPUT D
20 LET F=0
21 LET A=A*(12/B)
22 LET E=(C/100)/B
24 LET G=B*D
26 LET T1=0
30  LET T1=T1+1
40 IF T1=G+1 THEN 130
50 LET F=(1+E)*(F+A)
60 GO TO 30
130 LET F=INT(100*F+.5)/100
135 PRINT
136 PRINT
140 PRINT "AFTER"D"YEARS YOU WILL HAVE $"F
145 PRINT
146 PRINT
150 GO TO 6
999 END
```

```
RUN

THIS PROGRAM WILL CALCULATE THE BALANCE OF A SAVINGS
ACCOUNT IN WHICH DEPOSITS ARE MADE REGULARLY.

HOW MUCH WILL YOU SAVE EACH MONTH? 100
HOW MANY INTEREST COMPOUND PERIODS EACH YEAR? 4
AT WHAT RATE OF INTEREST (XX.X%)? 5
HOW MANY YEARS WILL YOU MAKE THIS SAVING? 5


AFTER 5 YEARS YOU WILL HAVE $ 6853.5



HOW MUCH WILL YOU SAVE EACH MONTH? 20
HOW MANY INTEREST COMPOUND PERIODS EACH YEAR? 2
AT WHAT RATE OF INTEREST (XX.X%)? 5.5
HOW MANY YEARS WILL YOU MAKE THIS SAVING? 10


AFTER 10 YEARS YOU WILL HAVE $ 3230.14



HOW MUCH WILL YOU SAVE EACH MONTH? 10
HOW MANY INTEREST COMPOUND PERIODS EACH YEAR? 365
AT WHAT RATE OF INTEREST (XX.X%)? 5
HOW MANY YEARS WILL YOU MAKE THIS SAVING? 6


AFTER 6 YEARS YOU WILL HAVE $ 839.69



HOW MUCH WILL YOU SAVE EACH MONTH? 10
HOW MANY INTEREST COMPOUND PERIODS EACH YEAR? 1
AT WHAT RATE OF INTEREST (XX.X%)? 3.75
HOW MANY YEARS WILL YOU MAKE THIS SAVING? 6


AFTER 6 YEARS YOU WILL HAVE $ 820.63
```

AREA: Business/Math NUMBER: NAME: ROUNDOFF
SOURCE: F. McPhetres, Hartford High School LANGUAGE: BASIC

DESCRIPTION: Frequently, it is desirable to round off numbers to 2 decimal places (cents), 0 decimal places (dollars), -2 decimal places (hundreds of dollars), etc. If you wish to round off a decimal number in a program of your own, simply insert the following line:

```
LET R = INT(W*10↑Y+0.5)/(10↑Y)
```

W is the number you wish to round off (or a variable which represents the number) while Y is the number of decimal places desired. That is, Y is 3 if you wish to round to the nearest thousandth, 2 to round to hundredths, 0 to round to the nearest whole number, -1 to round to the nearest multiple of 10, etc.

Below is a program whose sole function is to round off decimal numbers.

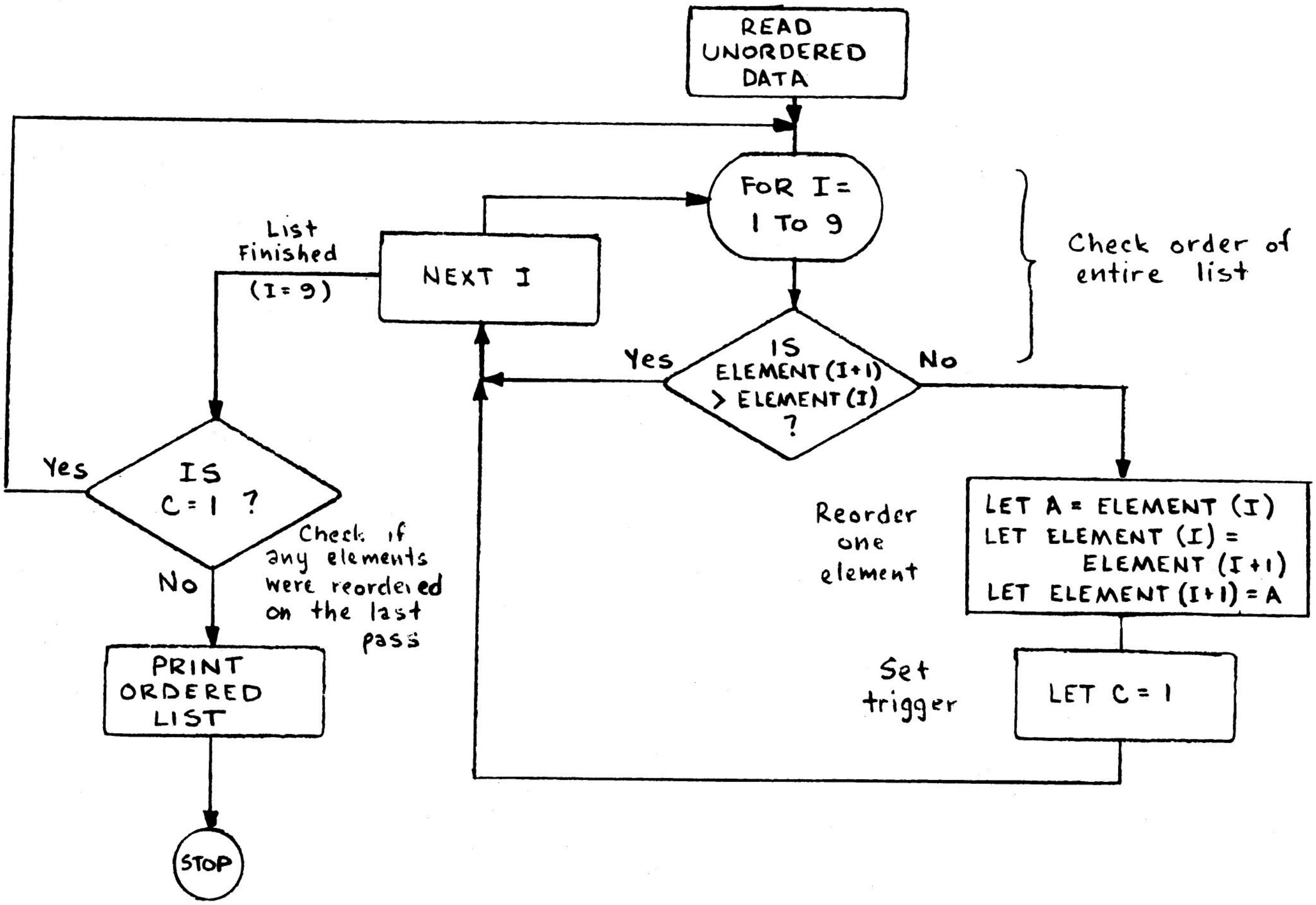
```
100 PRINT "WHAT NUMBER DO YOU WISH TO ROUND OFF";
110 INPUT N
120 PRINT "TO HOW MANY PLACES";
130 INPUT Y
140 PRINT
150 LET A=INT(N*10↑Y+0.5)/(10↑Y)
160 PRINT N "=" A "TO" Y "DECIMAL PLACES."
170 PRINT
180 GOTO 100
190 END
```

```
RUN

WHAT NUMBER DO YOU WISH TO ROUND OFF? 56.0237
TO HOW MANY PLACES? 2

 56.0237 = 56.02 TO 2 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 8.449
TO HOW MANY PLACES? 1

 8.449 = 8.4 TO 1 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 3.685
TO HOW MANY PLACES? 2

 3.685 = 3.68 TO 2 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 3.67499
TO HOW MANY PLACES? 2

 3.67499 = 3.67 TO 2 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 3.67501
TO HOW MANY PLACES? 2

 3.67501 = 3.68 TO 2 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 2348
TO HOW MANY PLACES? 0

 2348 = 2348 TO 0 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 2348.6
TO HOW MANY PLACES? -1

 2348.6 = 2350 TO-1 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 2348.6
TO HOW MANY PLACES? -2

 2348.6 = 2300 TO-2 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 2348.6
TO HOW MANY PLACES? -3

 2348.6 = 2000 TO-3 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 2348.6
TO HOW MANY PLACES? -4

 2348.6 = 0 TO-4 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? -2.3469
TO HOW MANY PLACES? 3

-2.3469 =-2.347 TO 3 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF? 2
TO HOW MANY PLACES? 4

 2 = 2 TO 4 DECIMAL PLACES.

WHAT NUMBER DO YOU WISH TO ROUND OFF?
↑C
```

AREA: Business NUMBER: 8-501 NAME: SORT-1
SOURCE: Digital Equipment Corp. LANGUAGE: BASIC

DESCRIPTION: In business data processing, it is frequently necessary to sort a list of data into order. For example, some lists must be sorted by age, zip code, weight, inventory level, etc. This program is one way in which sorting can be done. The problem is to read in 10 numbers as DATA and then print them out sorted from smallest to largest.

APPROACH: In this type of problem, it is best to start with a flow-chart.



```
READY

LIST
   2 DIM A(10),I(10)
   5 PRINT "RANDOMLY ORDERED DATA"
  10 FOR I=1 TO 10
  20 READ A(I)
  30 PRINT A(I);
  40 NEXT I
  50 LET C=0
  55 REM  CHECK IF ALL ELEMENTS IN LIST ARE ORDERED
  60 FOR I=1 TO 9
  70 IF A(I+1)<A(I) THEN 200
  80 NEXT I
  85 REM  C INDICATES IF AN ELEMENT WAS REORDERED
  90 IF C=0 THEN 300
 100 GO TO 50
 195 REM  REORDER ONE ELEMENT
 200 LET A=A(I)
 210 LET A(I)=A(I+1)
 220 LET A(I+1)=A
 230 LET C=1
 240 GO TO 80
 300 PRINT
 301 PRINT
 302 PRINT "ORDERED DATA"
 310 FOR I=1 TO 10
 320 PRINT A(I);
 330 NEXT I
 400 DATA 10,5,1,9,4,8,3,7,2,6
 999 END

READY

RUN

RANDOMLY ORDERED DATA
 10  5  1  9  4  8  3  7  2  6

ORDERED DATA
 1  2  3  4  5  6  7  8  9  10

READY




400 DATA 62,64,89,100,95,73,50,95,80,87

RUN

RANDOMLY ORDERED DATA
 62  64  89  100  95  73  50  95  80  87

ORDERED DATA
 50  62  64  73  80  87  89  95  95  100

READY
```

AREA: Business NUMBER: NAME: SORT-2
SOURCE: Computer Methods in Mathematics LANGUAGE: BASIC

DESCRIPTION: Given a list of eight numbers: 75, 83, 67, 52, 99, 66, 83, 72. Sort the numbers into increasing order, left to right.

52, 66, 67, 72, 75, 83, 83, 99

Let the computer do it. A program and RUN are shown on the following page. Examine them.

How does the program work? Add the following statements and RUN the program. The printout will show you the status of the list <u>after</u> Lines 420 through 480 have been carried out for I = 1, then I = 2 and so on.

```
473 PRINT "I=";I;"LIST IS";
477 GOSUB 800
505 PRINT
```

The original list of numbers is in Line 901. To sort a different list of eight numbers, simply change Line 901. Try it for the following lists, using the modified program, including Lines 473, 477, and 505.

(1) 2, 1, 3, 4, 5, 6, 7, 8

(2) 1, 2, 3, 4, 5, 6, 8, 7

(3) 4, 3, 2, 1, 5, 6, 7, 8,

(4) 8, 7, 6, 5, 4, 3, 2, 1

If you need more evidence, delete Lines 473, 477, and 505, then add the following Lines and RUN the program for the above lists.

```
415 PRINT "FOR I=";I;"AND"
470 PRINT "J="; J;"LIST IS";
471 GOSUB 800
472 NEXT J
```

```
100 REMARK   SORT EIGHT NUMBERS
110 PRINT "THIS PROGRAM SORTS A LIST OF EIGHT NUMBERS INTO"
120 PRINT "INCREASING ORDER AND PRINTS THE FINAL LIST WITH"
130 PRINT "THE SMALLEST NUMBER FIRST AND LARGEST LAST"
140 PRINT
200 REMARK   READ EIGHT NUMBERS INTO X(1), X(2),...,X(8)
210 DIM X(10)
220 FOR K=1 TO 8
230 READ X(K)
240 NEXT K
300 REMARK   PRINT THE ORIGINAL (UNSORTED) LIST
310 PRINT "UNSORTED LIST   ";
320 GOSUB 800
330 PRINT
400  REMARK   SORT THE NUMBERS
410 FOR I=1 TO 7
420 FOR J=I+1 TO 8
430 IF X(I) <= X(J) THEN 470
440 LET T=X(I)
450 LET X(I)=X(J)
460 LET X(J)=T
470 NEXT J
480 NEXT I
500 REMARK   PRINT THE FINAL (SORTED) LIST
510 PRINT "SORTED LIST     ";
520 GOSUB 800
530 STOP
800 REMARK   SUBROUTINE TO PRINT X(1), X(2),...,X(8)
810 FOR K=1 TO 8
820 PRINT X(K);
830 NEXT K
840 PRINT
850 RETURN
900 REMARK   HERE IS THE ORIGINAL LIST OF NUMBERS
910 DATA 75,83,67,52,99,66,83,72
999 END

RUN

THIS PROGRAM SORTS A LIST OF EIGHT NUMBERS INTO
INCREASING ORDER AND PRINTS THE FINAL LIST WITH
THE SMALLEST NUMBER FIRST AND LARGEST LAST

UNSORTED LIST     75  83  67  52  99  66  83  72

SORTED LIST       52  66  67  72  75  83  83  99


READY
```

Note: If you have trouble fitting the program into EDUSYSTEM 10, delete lines 100, 110, 120, 130, 200, 300, 400, 500 and 900. But <u>don't</u> delete Line 800.

AREA: Social Studies **NUMBER:** **NAME:** POPULATION
SOURCE: Gruenberger and Jaffray **LANGUAGE:** BASIC
Problems for Computer Solution, Wiley

DESCRIPTION: This program solves the following problem:
Assume that in 1960 the population figures for the United States and Mexico were 180,000,000 and 85,000,000 respectively. Assume also that the annual rate of growth for the United States in 1.23%, and that for Mexico, 2.23%. If these growth rates remain constant, in what year will the population of Mexico equal or exceed that of the United States

```
10 LET U=180000000
20 LET M=85000000
30 LET R1=1.0123
40 LET R2=1.0223
50 LET Y=1960
60 LET U=U*R1
70 LET M=M*R2
80 LET Y=Y+1
90 IF M<U THEN 60
100 PRINT "U.S. POPULATION IS"U"AND MEXICO IS"M"IN"Y
999 END

RUN

U.S. POPULATION IS 4.614066E+8 AND MEXICO IS 4.644644E+8 IN 2037
```

Modify the problem to take into account that the U.S. growth rate increases 0.01% each year and that of Mexico increases by 0.001% each year. Will the population of Mexico under these circumstances ever exceed that of the United States?

```
60 LET U=U*(1.01*R1)
70 LET M=M*(1.001*R2)
85 IF Y>10000 THEN 120
110 STOP
120 PRINT "U.S. STILL HAS MORE PEOPLE,"U"THAN MEXICO,"M"IN 10000."

RUN

 ???
```

Consider similar data as the first case for the U.S. (180,000,000) and California (15,700,000) for 1960, and growth rates of 1.23% and 3.70%. Applying the same routine, we would find a year in which the population of California exceeded the population of the United States, which is nonsense. Where is the discrepency?

Or try this version of the problem. In 1963, the United States consumption of motor fuel was 64,000,000 gallons, increasing by 4 percent per year. The consumption in California was 6,000,000, increasing 5.4 percent per year. In what year will California consume more than the United States.

EDUCATIONAL BENEFIT: The principle illustrated by the last two exercises is that of GIGO - "garbage in, garbage out." If the problem definition is intrinsically nonsensical, then the application of the computer to it will add no sense. Blaming the nonsensical result, then, on the computer is not fair, but we see examples of it frequently.

The last problem could make sense if we ask in what year the consumption of fuel in California exceeds that of the remainder of the United States, if ever?

AREA: Social Studies
SOURCE: David H. Ahl, DEC
NAME: SMOG
LANGUAGE: BASIC

This program is an adaptation of the Smog Model written by Herbert Peckham of Gavilan College, Gilroy, California. The model assumes that vehicular traffic is the sole producer of smog (a very bad assumption!), and also assumes that most automobile traffic occurs during the daylight hours and that traffic volume is very low (zero) at night. It further assumes that smog is dissipated by atmospheric conditions which vary depending upon sunlight, temperature, and weather. All of these conditions may be specified by the user.

The model could be improved significantly by taking into account other sources of smog, by varying vehicular traffic according to the hour of the day and by allowing daily variation of the weather factors. Nevertheless, in its current form it is quite instructive.

NOTE: A plot of smog values is produced in Statements 320 and 340. In the listing, the smog value, S, is multiplied by 2 for the plot. Under some conditions, the value of smog reaches 30 or 40 which, when multiplied by 2 is 60 to 80, a value greater than the width of the paper. The simplest solution is to simply print out the table of smog values with no plot; a more elegant solution would be to estimate the maximum value from the input factors and calculate an appropriate plotting multiplication factor.

```
LIST

 10 PRINT "SMOG CITY SIMULATION PROGRAM"
 15 T=7
 20 PRINT
 25 PRINT "THIS PROGRAM REPRESENTS A MODEL OF A CITY WITH CERTAIN"
 30 PRINT "CONDITIONS WHICH YOU MAY SPECIFY.  THE PROGRAM WILL THEN"
 35 PRINT "PRINT OUT THE RESULTING SMOG PATTERNS BY HOUR OF THE DAY"
 40 PRINT
 45 PRINT "CARS PER MILE OF ROAD"
 50 PRINT "EXAMPLES:  LOS ANGELES   200 CARS PER MILE"
 55 PRINT "           DETROIT       100"
 60 PRINT "           TULSA          25"
 65 PRINT "HOW MANY CARS PER ROAD MILE IN SMOG CITY";
 70 INPUT C
 75 PRINT
 80 PRINT "SMOG GENERATION CONSTANT"
 85 PRINT "EXAMPLES:  1950 AUTO   .005"
 90 PRINT "           1972 AUTO   .001"
 95 PRINT "           BUS         .010"
100 PRINT "WHAT IS THE AVERAGE VALUE IN SMOG CITY";
105 INPUT L1
108 PRINT
110 PRINT "DAYTIME SMOG BREAKDOWN RATE (% PER HOUR)"
115 PRINT "EXAMPLES:  CLEAR  0.02"
120 PRINT "           CLOUDY 0.01"
125 PRINT "DAYTIME RATE IN SMOG CITY";
130 INPUT R1
135 PRINT
140 PRINT "NIGHTTIME SMOG BREAKDOWN RATE (% PER HOUR)"
145 PRINT "EXAMPLES:  HOT   0.05"
150 PRINT "           COOL  0.10"
155 PRINT "NIGHTTIME RATE IN SMOG CITY";
160 INPUT R2
165 PRINT
170 PRINT "SMOG DISPERSION FROM WEATHER (% PER HOUR)"
175 PRINT "EXAMPLES:  HIGH WIND AND RAIN   1.00"
180 PRINT "           NO WIND AND DRY      0.01"
185 PRINT "DISPERSION FROM WEATHER IN SMOG CITY";
190 INPUT R3
195 PRINT
200 PRINT
210 PRINT "HOUR","SMOG LEVEL"
215 PRINT
220 R=R1
225 K1=L1
230 T1=INT((T-6)/12)
240 IF T1/2=INT(T1/2) THEN 270
250 K1=0
260 R=R2
270 S=S+K1*C*10-R*S-R3*S
275 IF S>0 THEN 280
278 S=0
280 T=T+1
290 T3=INT(T/12)
300 T2=T-T3*12+1
310 IF T3/2=INT(T3/2) THEN 340
320 PRINT T2" PM",S,TAB(32+2*S);"X"
330 GOTO 220
340 PRINT T2" AM",S,TAB(32+2*S);"X"
350 GOTO 220
999 END

READY
```

```
RUN
SMOG CITY SIMULATION PROGRAM

THIS PROGRAM REPRESENTS A MODEL OF A CITY WITH CERTAIN
CONDITIONS WHICH YOU MAY SPECIFY.  THE PROGRAM WILL THEN
PRINT OUT THE RESULTING SMOG PATTERNS BY HOUR OF THE DAY

CARS PER MILE OF ROAD
EXAMPLES:  LOS ANGELES   200 CARS PER MILE
           DETROIT       100
           TULSA          25
HOW MANY CARS PER ROAD MILE IN SMOG CITY? 100

SMOG GENERATION CONSTANT
EXAMPLES:  1950 AUTO   .005
           1972 AUTO   .001
           BUS         .010
WHAT IS THE AVERAGE VALUE IN SMOG CITY? .001

DAYTIME SMOG BREAKDOWN RATE (% PER HOUR)
EXAMPLES:  CLEAR  0.02
           CLOUDY 0.01
DAYTIME RATE IN SMOG CITY? .01

NIGHTTIME SMOG BREAKDOWN RATE (% PER HOUR)
EXAMPLES:  HOT   0.05
           COOL  0.10
NIGHTTIME RATE IN SMOG CITY? .1

SMOG DISPERSION FROM WEATHER (% PER HOUR)
EXAMPLES:  HIGH WIND AND RAIN   1.00
           NO WIND AND DRY      0.01
DISPERSION FROM WEATHER IN SMOG CITY? .05


HOUR SMOG LEVEL

 9  AM             1              X
 10  AM            1.94            X
 11  AM            2.8236            X
 12  AM            3.654184            X
 1  PM             4.434933             X
 2  PM             5.168837               X
 3  PM             5.858707                X
 4  PM             6.507184                  X
 5  PM             7.116753                   X
 6  PM             7.689748                    X
 7  PM             8.228363                     X
 8  PM             6.994109                  X
 9  PM             5.944993                X
 10  PM            5.053244               X
 11  PM            4.295257             X
 12  PM            3.650969            X
 1  AM             3.103323           X
 2  AM             2.637825          X
 3  AM             2.242151         X
 4  AM             1.905828        X
 5  AM             1.619954        X
 6  AM             1.376961       X
 7  AM             1.170417       X
 8  AM             2.100192         X
 9  AM             2.97418           X
 10  AM            3.79573             X
 11  AM            4. 567986              X
 12  AM            5. 293907               X
 1  PM             5. 976272                X
 2  PM             6. 617696                  X
 3  PM             7. 220634                   X
 4  PM             7. 787396                    X
 5  PM             8. 320152                     X
 6  PM             8. 820943                      X
 7  PM             9. 291687                       X
 8  PM             7. 897934                    X
 9  PM             6. 713244                  X
 10  PM            5. 706257                X
 11  PM            4. 850319              X
 12  PM            4. 122771             X
 1  AM             3. 504355            X
 2  AM             2. 978702          X
 3  AM             2. 531897          X
 4  AM             2. 152112         X
 5  AM             1. 829295        X
 6  AM             1. 554901        X
 7  AM             1. 321666       X
 8  AM             2. 242366         X
 9  AM             3. 107824           X
 10  AM            3. 921355            X
 11  AM            4. 686073              X
 12  AM            5. 404909               X
 1  PM             6. 080614                 X
 2  PM             6. 715778                  X
 3  PM             7. 312831                   X
 4  PM             7. 874061                    X
 5  PM             8. 401617                     X
 6  PM             8. 89752                       X
 7  PM             9. 363669                       X
 8  PM             7. 959119                    X
 9  PM             6. 765251                  X
 10  PM            5. 750463                X
 11  PM            4. 887894              X
 12  PM            4. 15471              X
 1  AM             3. 531503            X
 2  AM             3. 001778
STOP

READY
```

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